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Design and Development of Smart Solar Charging Station

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ABSTRACT

The easy bike (EB) is an electric vehicle that has quickly gained popularity in India's public transit system. EBs are battery-operated, limited-range vehicles. Long-distance trips on simple bikes frequently need stopping at charging facilities to top out the bikes' batteries. Our administration has significant hurdles in the areas of electric vehicle charging infrastructure and renewable energy. Using a photovoltaic (PV) power generating system and an energy storage system, it presents a cutting-edge commercial charging station for EBs that draws practically all of its electricity from renewable energy sources. In case of grid failure, an emergency back-up mechanism is put in place. Solar energy is converted into electricity and stored in a battery bank using this technique. The batteries are protected from overcharging by a microprocessor, which also disables the device when power is needed to recharge the batteries.

Energy that is replenished over time is called "renewable energy," and it may come from a variety of sources. It offers eco-friendly power that is derived from renewable resources. Increasing renewable energy use will reduce the need for, and the cost of, fossil fuels. Heating, cooking, and electricity generating are just few of the many common uses for solar photovoltaic energy. Electricity costs and losses from charging and discharging will go down if this system is put into place. By charging electric car batteries using solar energy, we lessen the strain on the grid and cut down on emissions. Combining low-carbon PV power production with emission-free EVs may help mitigate the greenhouse gas issue caused by internal combustion (IC) engines. This new solar charging station's output will create renewable energy to charge EV batteries, lowering pollution levels and improving environmental sustainability.

Keywords: Solar, Charging Station, Easy Bikes

1.Introduction

Due to decreased operating and maintenance expenses, easy bikes (battery-run rickshaws or electric three-wheelers) are becoming more popular over the whole of India. The typical range of an EB is between 80 and 100 kilometers, and it can comfortably seat four to five people. It uses 1 kilowatt-hour (kW) of power each day and takes more than 4 hours to fully recharge its five lead-acid batteries (with a maximum voltage of 60 V). When opposed to cars powered by traditional internal combustion engines, EB offers significant environmental advantages. The country's transportation industry is less reliant on imported fossil fuels thanks to this car. In addition, it is air pollution-free, making it environmentally beneficial. In addition, using simple bikes may help India save a billion dollars annually. The battery charging station that can be built to meet the demand for the EBs is only getting started, and the solar-based battery charging station is the first step. There are only 12 battery charging facilities in India, despite the fact that there is a need for 9,000,000 simple bikes.

However, the vast majority of EBs are charged via residential connections, which places an unnecessary strain on the power system. In order to reduce the load on the electrical grid, the administration is open to the idea of charging EB batteries with solar energy. Because wind power is not practical everywhere, it is not accounted for in the model. The goal of this model's design is to enhance already-existing battery charging stations and set up more charging stations with their own power capacity. This approach will be especially useful in densely populated regions and rural areas where power outages are frequent.

1.2 Existing system

As the demand for energy is high and the number of electric vehicles on the road is low, charging outlets for these vehicles are few and far between. The current system's primary drawback is that it relies only on grid supply, making it very difficult to regulate power use. The power requirement in the current system is not being met by a hybrid energy source.

1.3 Proposed system

If we charge a completely depleted battery with an excessive amount of current, the battery will explode. An efficient battery charging system is essential to deal with these issues, as leaving a battery in the charging mode for an extended period of time (overcharging) causes gassing of hydrogen and oxygen at the electrode plates, which washes away the energetic material coated on the plates and ultimately causes failure of battery. This work introduces a low-cost solar battery charger for direct current (DC) loads, which include DC lighting fixtures (such as LEDs), DC gadgets (such as laptops, cellphones, satellite TV for pc TV controllers, and so on.

Because of improvements in battery safety and longevity enhancements, the sophisticated equipment can record and save data for distant monitoring. The suggested system's block diagram is shown in Figure 2. A solar panel, charge controller with an Arduino interface, Wi-Fi module, battery bank, and load make up the conventional solar PV standalone device, which supplies useful power to the end user.

1.4 Objectives

1) Cell Protection: One of the primary roles of the Battery Management System is to provide cell protection that is located outside of the battery.

2) Charge Control: This is essentially BMS's defining characteristic. Incorrect charging is the leading cause of battery failure.

3) Demand Management: The term "demand management" refers to the application that makes use of the battery, and has nothing to do with the battery's internal workings.

4) SoC Determination: This may simply be for providing the user with an indication of the capacity left in the battery, or it could be needed in a control circuit to ensure optimum control of the charging process.

5) SoH Determination: This is crucial for determining whether any maintenance is required on the emergency power equipment.

6) Cell Balancing: To compensate for less powerful cells in a battery pack, cell balancing charges all the cells to the same level.

2. Literature survey

1. Bangladesh's economy and standard of living might benefit greatly from the integration of a sustainable power source with a transportation infrastructure. Gaseous petrol and gasoline are Bangladesh's principal energy sources for cars. Concerns are raised, however, concerning the sustainability of these energy sources in light of the rapid depletion of the gas reserve, rising gas prices, and a global shift in climate, not to mention the environmental pollution caused by human use of fuel. The use of renewable energy might be the solution to these problems. The focus of this study is on the most extreme applications of a solar-powered photovoltaic (PV) system for powering electric cars while minimizing their carbon footprint. The electric car charging station and the national mix's surplus capacity might benefit from an imperfect use of this structure. Hybrid Optimization of Multiple Energy Renewable (HOMER) software is used to simulate the demonstration, which includes an ideal analysis of the green transportation framework. The PV system is capable of producing up to 13,792 kWh annually. About 21% of total production may be used at the charging station to power electric cars, while the rest can be sent into the national grid. The suggested green vehicle concept would also reduce ozone-depleting chemical emissions by 52,944 kilowatt-hours per year.

2. Since around the middle of 2010, the automotive sector has seen the greatest increase in its use of petroleum. The transportation sector is responsible for 35% of all CO2 emissions. Clean energy utilization strategies have been accepted in this particular context, with electromobility serving as the basic order. In this study, we investigate the feasibility of charging electric car batteries using clean energy generated from renewable solar resources. A charging station for electric cars with solar boards and batteries required a different structure to be built, sized, and replicated in action. We simulated the performance of the enhanced Hybrid Optimization by Genetic Algorithms (iHOGA) version 2.4 software that was used to complete the optimal layout of the photovoltaic framework. The solar system must be planned such that the charging station always has enough electricity to flexibly charge a small number of electric cars at any given time of day or night. The key results focused on the framework's vitality, ecological, and financial performance during the course of one year of operation.

3. This research presents the solar and wind energy based charging instrument (SWCM) that may be used to charge EV batteries. Solar photovoltaic (PV) modules and a wind generator work together to power the environmentally friendly charging station. The SWCM drastically reduces the need for fossil fuels in power generation, resulting in drastically lower emissions of carbon monoxide and other greenhouse gases. An explanatory demonstration has been finished for wind vitality age, and the single diode model has been used to illustrate renewable sources like wind and sunlight. The suggested SWCM's reconstruction model was developed in MATLAB-Simulink. varying irradiance levels and varying stacking circumstances (1 kW and 3 kW) are used to emphasize the I- V and PV attributes of the daylight-based board. The PV modules and wind turbine are connected to two unidirectional direct current (DC) to direct current (DC) converters, while the ten charging nodes are connected to six bidirectional DC-DC converters that provide power for charging electric vehicles. The suggested framework is connected to the lattice through a three-stage bidirectional DC-AC (alternating current) inverter in order to control the heap request. The obtained results demonstrate that the suggested endless charging component is cost-effective for EV charging, leading to a pristine environment.

3.Requirement specifications

3.1 Hardware Requirement

- Arduino uno
- Voltage sensor
- Current sensor
- Load mofset
- LCD display
- Regulator
- Solar panel
- Buzzer
- Lithium-ion battery

3.2 Software Requirement

- Arduino
- Blynk application

4.Methodology

4.1 Proposed Methodology

The goal of this project is to create a solar-powered charging station for tiny electric vehicles that may be used on campus. Theoretical calculations of our system's voltage, current, and output power are a part of this research. The selection of appropriate components and the development of an electric circuit that fulfills the requirements of the project constitute an electronic design. The mechanical layout of the finished product is also included. Phase III: Implementing Final Results, Prototyping

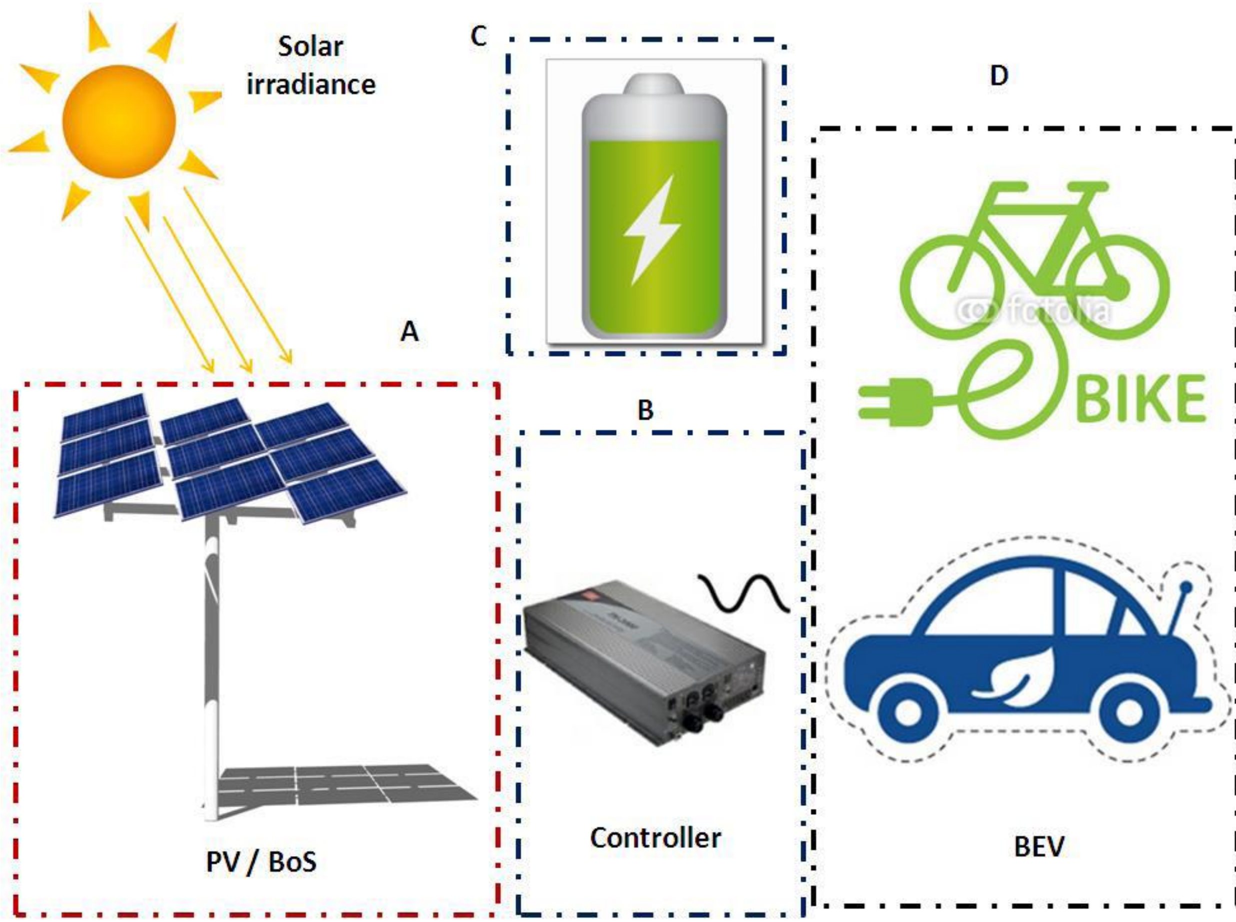

Figure 1: PV_CS main research streams; A: PV and system components; B: Controller; C: Battery storage; D; Electric v

Photovoltaic Charging Station power requirements

Based on our prior experience with electrical systems and the study we conducted on comparable models, we came to the conclusion that this project should follow the same format. There must be an input, processing, and final product. Solar panels will serve as our power supply. The microcontroller's role in the system will be to regulate the charging process. The system's block diagram is shown in Figure 1 below. The microprocessor would also monitor the battery's voltage and current to decide when it should be turned off for charge or usage.

If we provide the coordinates to the National Renewable Energy Laboratory (NREL), they will tell us how much energy can be generated from the sun in a year. Their forecasts take into consideration factors such as cloud cover, precipitation, temperature, and latitude. Here in southern middle Tennessee, where I now reside, we may anticipate

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about 4.7 hours of comparable sun output every day. The annual energy production from a 30-watt panel is equal to 51,465 watt-hours. About 30 years of output may be expected from this panel.

4.2 BLOCK DIAGRAM

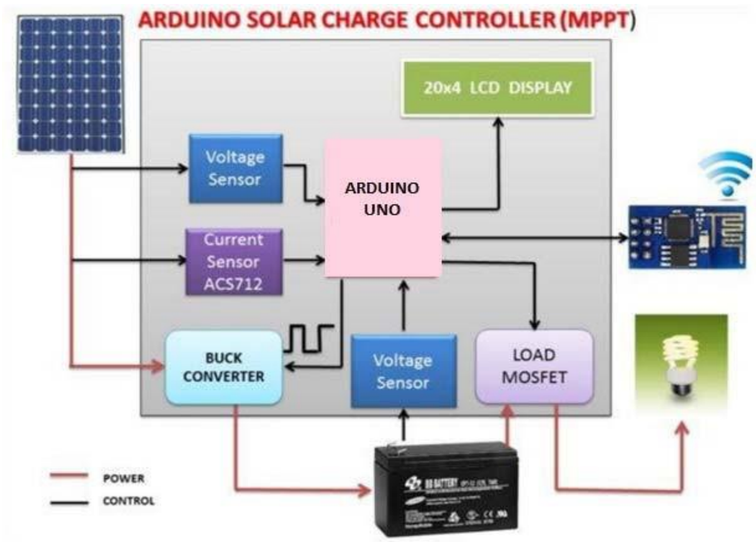

Figure 2: block diagram of solar charging station for EV

Arduino UNO

Overview

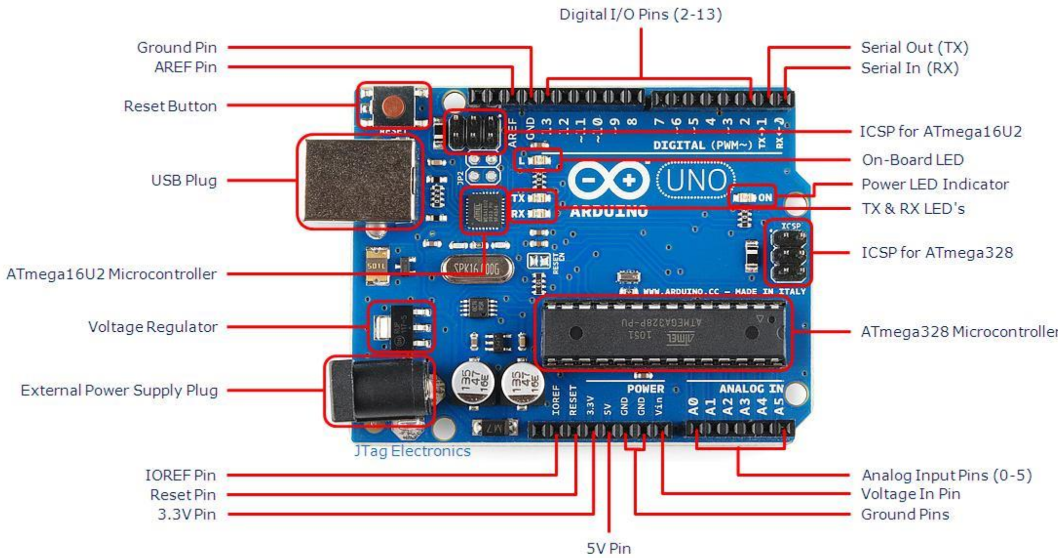

Fig 3: Arduino UNO

Specifications:

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	(recommended) 7-12V
Input Voltage	(limits) 6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input	Pins 6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

Input and Output

Using the pinMode(), digitalWrite(), and digitalRead() routines, each of the Uno's 14 digital pins may be set as either an input or an output. They need 5 volts to function. Each pin contains a pull-up resistor of 20-50 k Ohms that may be used to provide or receive up to 40 mA. Some of the pins also serve specific purposes:

- **Serial: 0 (RX) and 1 (TX):** Used for both receiving and sending TTL serial data (RX and TX). The ATmega8U2 USB-to-TTL Serial chip's relevant pins are wired here.
- **External Interrupts: 2 and 3:** Low value, rising/falling edge, or value change may all be used to set off an interrupt on these pins. For further information, refer to the attach Interrupt() method.
- **PWM: 3, 5, 6, 9, 10, and 11:** The analog Write() method may be used to generate 8-bit PWM output.
- **SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK) :** Using the SPI library, you may communicate with these pins.
- **LED: 13:** LED lighting is included and wired to digital pin 13. The LED lights up when the pin's value is HIGH, and it goes dark when the value is low.

Each of the Uno's six analog inputs (designated A0 through A5) can read a value from 0 to 1023 (10 bits of precision). The default measuring range is from ground to 5 volts, however the AREF pin & analog Reference() function allow the top limit to be adjusted. In addition, several pins provide particular purposes:

 TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication utilising Wire library.

There are a couple of other pins on board:

 AREF: Analog input reference voltage. Pairs well with Reference()'s analog counterpart.

 Reset: By making this line LOW, the microcontroller may be reset. Commonly used when a shield will be blocking the on-board reset button..

You may also check out the pinout for the ATmega328 in relation to the Arduino. The Atmega8, 168, and 328 all use the same mapping.

Communication

Connecting an Arduino Uno to a PC, another Arduino, or another microcontroller is easy because to the board's many onboard ports. Digital pins 0 (RX) and 1 (TX) on the ATmega328 may be used for UART TTL (5V) serial communication. The board's ATmega16U2 acts as a virtual com port, facilitating serial communication through USB. The '16U2 firmware operates with the default USB COM drivers, therefore there is no need for a third-party driver. However, a.inf file is essential for Windows. A serial monitor is included into the Arduino IDE and may be used to transmit and receive basic textual data with the Arduino board. If data is being sent from the board to the computer through the USB-to-serial chip (but not via serial communication on pins 0 and 1), the board's RX and TX LEDs will flash.

A Program The Uno's digital pins may be used for serial communication thanks to the Serial library.

In addition to I2C (TWI), the ATmega328 is both SPI and I2C capable. Wire is a library included into the Arduino IDE that makes it easier to communicate over the I2C bus. The SPI library is all you need for SPI communication.

HOW PV CELLS WORK:

Figure 4: PV cells

A silicon PV cell is made up of a thin wafer with a layer of boron-doped (P-type) silicon on top of a layer of phosphorus-doped (N-type) silicon that is much thicker. Where these two materials meet, at the cell's top surface, they form a junction known as a P-N junction, which generates an electric field.
A thin grid of metal is put to the top of the cell rather than a continuous sheet since it must be exposed to sunlight. The grid must be somewhat narrow to let in sufficient quantities of solar energy, yet relatively broad to transport the necessary electrical current.

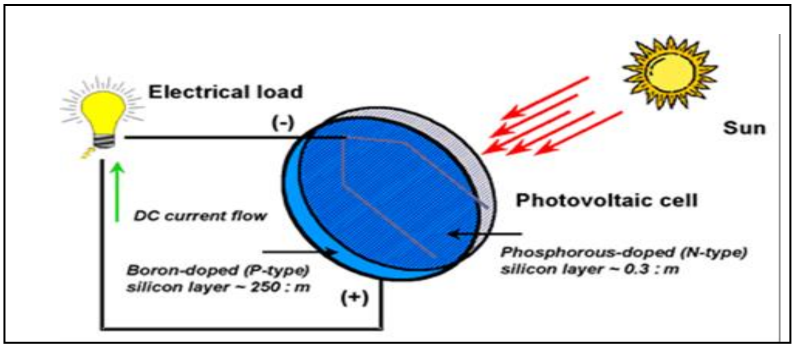

Figure 5: process of pv cells

There is a tendency to characterize all forms of light, including sunshine, as discrete "photons." When sunlight hits a photovoltaic cell, it lets photons inside.

A "hole" is created when an electron is ejected from its orbit after being hit by a photon. The free electron climbs to the cell's outermost membrane. Electrons are continually displaced and moving higher as photons continue to flood the cell.

Outside the cell, if there is a connection between the top grid and the back plane, electrons will start to flow. Free electrons flow from the cell's membrane and into the larger electrical system. When electron holes in a circuit are left unfilled, electrons from below in the circuit travel up to fill them.

Regardless of the surface area of the cell, most cells generate a voltage of roughly 0.5 V. A greater cell size, however, will result in a higher current output.

The cell's current and voltage will be affected by the circuit's resistance. Current generation is affected by the quantity of light available. The voltage of a cell changes as its temperature changes.

Under open-circuit, no-load circumstances, the voltage output of a typical silicon PV cell is between 0.5 and 0.6 volts DC. The amount of sunlight that strikes a PV cell's surface directly correlates to the amount of current (and power) the cell generates. A commercial PV cell with a surface area of 160 cm^2 (~25 in^2) will generate roughly 2 watts of peak power under ideal sunshine circumstances. This cell would generate around 0.8 watts if exposed to sunlight at 40% of its maximum intensity.

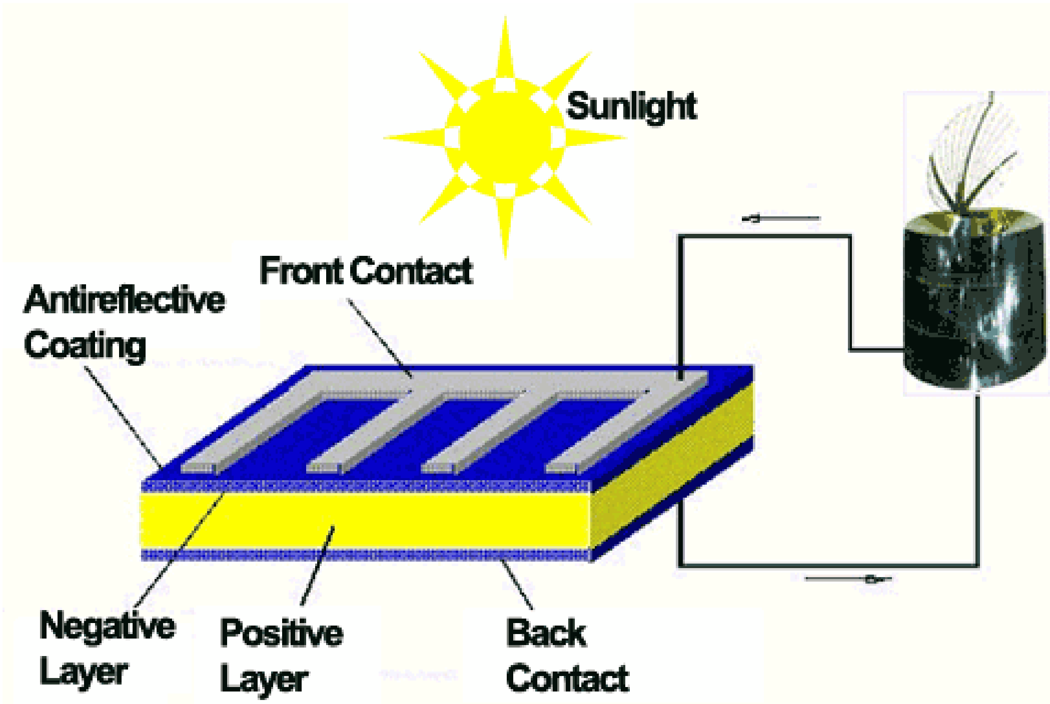

Figure 6: structure of PV cells

Regulator:

The output voltage of a regulator may be either fixed (usually 5, 12, or 15V) or adjustable. Their highest allowable current rating is also mentioned. There are negative voltage regulators that are useful for dual supply. 'Overload protection' and 'thermal protection' are two types of automated safeguards found in modern regulators. The 7805 +5V 1A regulator illustrated on the right is typical of the fixed voltage regulators ICs. These ICs typically have 3 leads and resemble power transistors. Using an LM7805 is a breeze. You acquire a 5 volt supply from the output pin by connecting the positive lead of your unregulated DC power source (anywhere from 9VDC to 24VDC) to the Input pin and the negative lead to the Common pin.

Fig 7: A Three Terminal Voltage Regulator

The LM78XX by Bay Linear is a three-pronged, integrated linear positive regulator. The LM78XX's several fixed output voltages make it suitable for a variety of uses. When substituting the LM78XX for a zener diode and resistor, the effective output impedance is often improved by two orders of magnitude, and the quiescent current is reduced. There are three different packaging options for the LM78XX: TO-252, TO-220, and TO-263.

Features:

• Output Current of 1.5A

• Output Voltage Tolerance of 5%

• Internal thermal overload protection

• Internal Short-Circuit Limited

• Output Voltage 5.0V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 24V.

LM78XX Series Voltage Regulators

General Description

The LM78XX family of three-terminal regulators has a broad variety of applications due to its set output voltage options. One such them is on-card local regulation, which avoids the complications of central control in terms of distribution. These regulators may be utilized in a wide variety of solid-state electronic devices due to the wide range of voltages they provide. These devices are often employed as fixed voltage regulators, but with the addition of certain additional components, variable voltages and currents may be obtained.

With proper heat dissipation, the LM78XX series' aluminum TO-3 packaging can handle loads of more than 1.0A. The peak output current may be kept to a safe level via the current limiting feature. To keep power dissipation within the device to a minimum, the output transistor is shielded from dangerous zones. The IC's thermal shutdown circuit kicks in if the power dissipation within the chip exceeds the capacity of the heat sink. The LM78XX family of regulators has had much work put into making them simple to operate and reducing the need for extra parts. Bypassing the output is not required but may enhance performance.

4.5 Liquid crystal display

Liquid Crystal Display is an abbreviation for this. For these and other reasons, LCD is quickly replacing LEDs (seven segment LEDs and other multi segment LEDs) in widespread applications.

1. The decrease in LCD costs.
2. The capacity to show data in the form of numbers, letters, and pictures. LEDs, on the other hand, can only display a few digits and a few letters.
3. The LCD has a built-in refreshing controller, thus it no longer has to rely on the CPU to do this function. However, the LED requires frequent CPU updates in order to maintain a steady show.
4. Character and graphical programming that is simple.

LCD SCREEN

LCD displays provide enough for 32 characters over two lines. A 5x7 dot matrix represents each character. The display's readability is affected by the voltage of the power source and by whether or not the messages are shown on one or two lines. Because of this, the pin labeled Vee receives a voltage that varies between 0 and Vdd. Typically, a trimmer potentiometer is used for this. Backlighting (using blue or green diodes) is an integral part of several screens. A current-limiting resistor must be employed under working conditions with any LE diode.

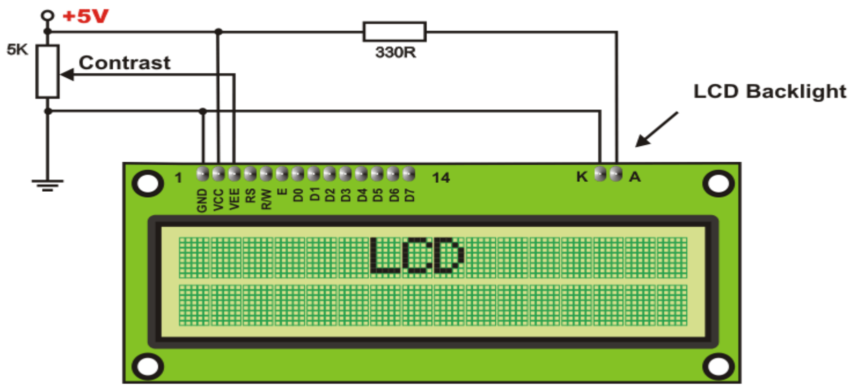

Fig 8: LCG Screen

Piezo Buzzer:

Fig 8: Buzzer

In 1831, Joseph Henry developed the first electric buzzer. Before musical chimes replaced them in the early 1930s, they were often employed in doorbells due to their gentle sound. A mechanical, electromechanical, or piezoelectric (short for piezo) buzzer or beeper is an audible signaling device. Typical applications for buzzers and beepers include alarms, timers, and the confirmation of user actions like clicking a mouse or typing a string of characters.
The piezo buzzer uses the piezoelectric effect backwards to create sound. The concept at work is electric potential applied across a piezoelectric material, which causes a change in pressure or strain. The user may be notified of an event that corresponds to a switching action, counter signal, or sensor input using these buzzers. They're also common in security system components.

No matter what voltage is added to the buzzer, it always makes the same grating noise. Piezo crystals are sandwiched between two conductors. When a voltage is placed across the crystals, they exert a force in the opposite direction on one of the conductors. A sound wave is the outcome of this interaction of force (push and pull). Most buzzers emit frequencies between 2 and 4 kilohertz.

4.6 ACS712 Current Sensor:

Basic Overview

Internet-available ACS712 Current Sensors were developed with microcontrollers like the Arduino in mind.

Allegro ACS712ELC chip is at the heart of these detectors.

Full scale values of 5A, 20A, and 30A are available for these current sensors.

Each of these tools essentially performs the same fundamental functions. As you'll see below, the only variation is the output scale factor.

Sensor Specifications:

	5A Module	**20A Module**	**30A Module**
Supply Voltage (VCC)	5Vdc Nominal	5Vdc Nominal	5Vdc Nominal
Measurement Range	-5 to +5 Amps	-20 to +20 Amps	-30 to +30 Amps
Voltage at 0A	VCC/2 (nominally 2.5Vdc)	VCC/2 (nominally 2.5Vdc)	VCC/2 (nominally 2.5VI
Scale Factor	185 mV per Amp	100 mV per Amp	66 mV per Amp
Chip	ACS712ELC-05A	ACS712ELC-10A	ACS712ELC-30A

Introduction to acs712 current sensor

The Acs712 is a current sensor that uses a hall effect. It is capable of measuring both DC and AC voltage and current. The sensor is of the linear kind. Allegro has created a fairly well-known integrated circuit with this one. It can filter out background noise and has a lightning-fast reaction time. The 1-and-a-half-percent output error may be fixed with careful coding by multiplying the observed value by the sensor's standard error. If a dc current is supplied to its input, a corresponding dc voltage is produced at the sensor's output; if an ac current is supplied, a corresponding ac voltage is produced. The output sensitivity of the sensor determines the value of the proportional term. Later on, I'll describe how the acs712 sensor's proportional sensitivity works.

Pin diagram of acs712 hall effect current sensor

The current sensor pin out for an acs712 is shown below. Current is sampled from pins 1, 2, and 3, 4.

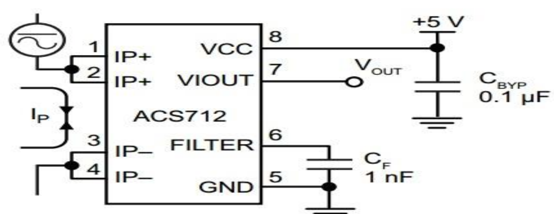

Fig 8: Buzzer

The filter capacitor is connected to pin 6, which is also the ground connection for the 5 volt power source. Connect the filter capacitor's ground pin to the other terminal's ground connection (pin 6). Like pin 7, vcc is a power supply pin that requires dc 5 volts to function. The acs712 current sensor's output is located on pin 7. Pin used for output.

5.System Development

Arduino

For those interested in building digital devices and interactive items that can detect and govern the real world, Arduino is a sort of computer software and hardware firm that provides an open-source environment for user projects and user communities. The Arduino proposal contains an integrated development environment (IDE) based on the Processing project that supports C, C++, and Java for programming the microcontrollers. It also works with embedded versions of C, C++, and Java.

Arduino is a user community, open-source hardware and software project, and manufacturer of kits for creating microcontroller-based gadgets and interactive objects with sensing and control capabilities. The boards include USB and other serial communications connections so they may be programmed on a computer and then uploaded to the board. The Arduino platform offers a Processing-based integrated development environment (IDE) with support for C, C++, and Java for writing code for the microcontrollers.

Arduino boards are made up of an Atmel 8, 16, or 32-bit AVR microcontroller and additional auxiliary components that make it easy to write code for and integrate with other circuits. The Arduino's standard connections are crucial because they allow users to attach the central processing unit (CPU) board to a wide range of shields, which are like modular expansion boards. Many shields allow for parallel stacking and usage by communicating with the Arduino board in different ways; some utilize the board's pins directly, while others use the I2C serial bus to be addressed separately. The ATmega8 and ATmega168 from the AVR mega family have been utilized in official Arduinos.

When opposed to other devices that normally need an external programmer, the Arduino's microcontroller comes pre-programmed with a boot loader that makes it easier to upload programs to the on-chip flash memory. Because of this, programming an Arduino doesn't need anything special—just a regular computer. The Arduino UNO comes preloaded with a boot loader called opti boot loader. When opposed to other devices that normally need an external programmer, the Arduino's microcontroller comes pre-programmed with a boot loader that makes it easier to upload programs to the on-chip flash memory. Because of this, programming an Arduino doesn't need anything special—just a regular computer.

7. Result and Discussion

PVsyst's energy balance information may be used to calculate the system's monthly and yearly energy output for EVs. The monthly output of each city's 8.1 kWp charging station varies according to the local climate and weather conditions. Figure 9 compares monocrystalline and polycrystalline modules in terms of PR for the system.

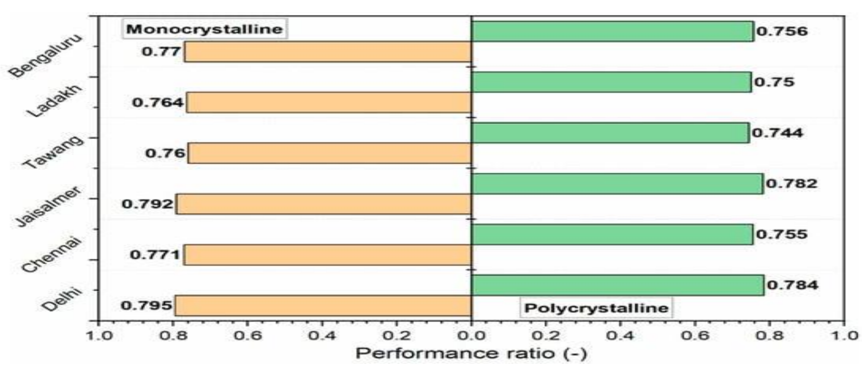

Figure 9. Performance ratio for the station in all six cities with different module technologies.

The monthly fluctuation in energy delivered by the system from monocrystalline and polycrystalline modules in six different cities is shown in Figure 10 and Figure 11, respectively. The station's charging schedule may be developed with the use of such a monthly study.

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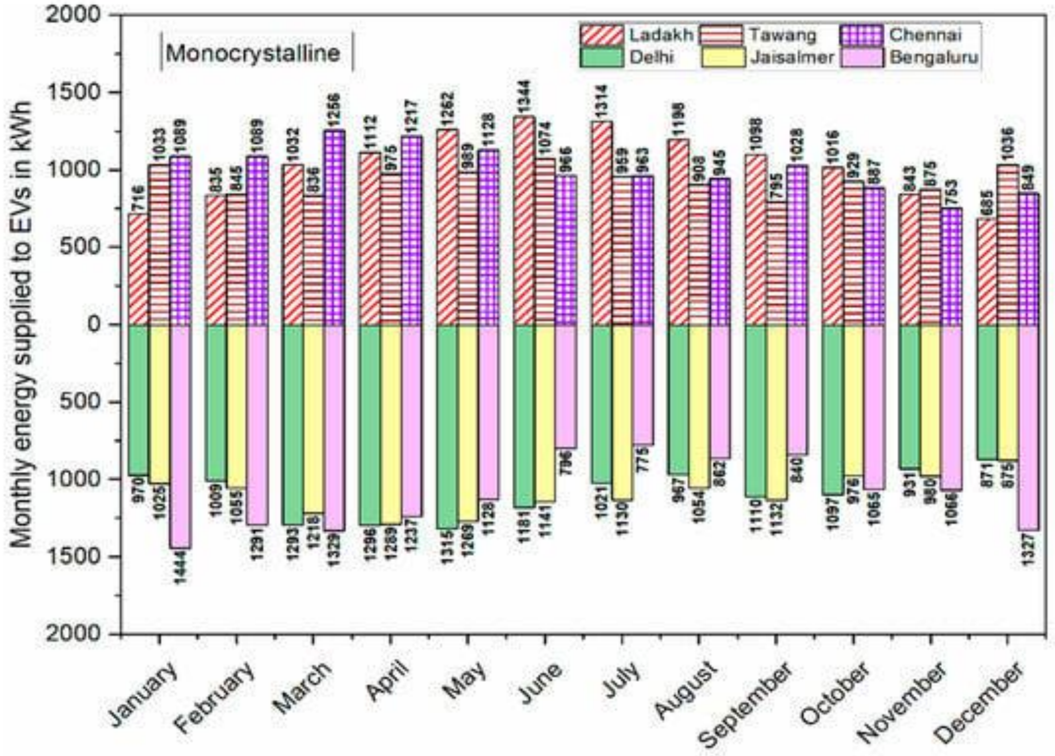

Figure 10. Monthly variation in energy supplied to EVs by the charging station using monocrystalline modules.

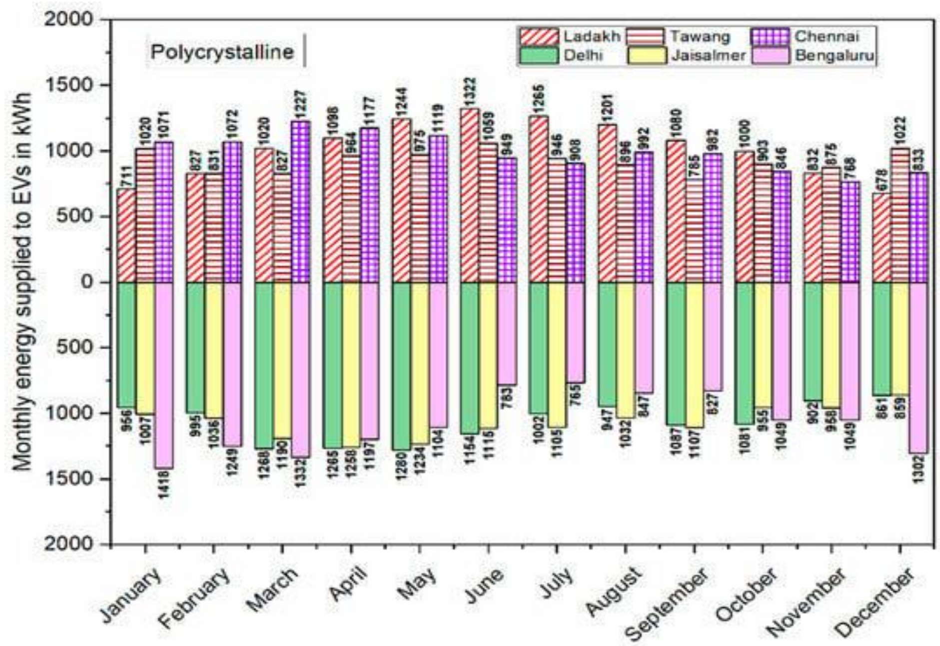

Figure 11. Monthly variation in energy supplied to EVs by the charging station using polycrystalline modules.

The charging station can power a certain number of electric vehicles, but that number is limited by the energy capacity of the vehicles' batteries. Here, we've tallied up the number of electric vehicles (EVs) with a 30-kilowatt-hour (kWh) battery that can be fully charged at each city's charging station [31]. Using monocrystalline and polycrystalline modules, respectively, Figure 14 and Figure 15 show the yearly energy delivered by the charging station to EVs and the number of fully charged EVs.

8.Conclusion And Future Scope

As was previously stated, this initiative is constrained financially. Industry sponsored projects are used extensively in Senior Design courses as a tool for both students and businesses to get exposure to the next generation of prospective workers. The idea for this solar station originated in the classroom, and no corporate backer contributed to its development. Our group has reached out to potential sponsors in the business world and is now in negotiations with one of them. In addition to financial backing, having an industrial sponsor provides students with a technical supervisor and collaborator who can aid in solving any research or design challenges that may occur. The purpose of the solar-powered charging station is to reduce reliance on finite resources and carbon-based fuels while also creating an outdoor energy source that can maintain itself. Based on their findings, the team decided that the university would benefit from having such a building, and that there was space for development in comparison to comparable charging stations. The team's research revealed that the other stations they examined were quite expensive to construct. A more effective charging station may also be possible with the help of the quickly developing solar inventions and designs.

Future scope

The number of electric motorbikes and bicycles in India is rapidly growing. Additionally, there are some electric automobiles, and the middle class is showing a growing interest in these vehicles.

This charging station has room to grow and eventually provide charging for both small and large automobiles. The supervisory computer may also use data from a weather forecasting website to provide an estimate of the amount of PV power that will be available.

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